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ABSTRACT

A study analyzed the policies of 20 Organisation for Economic Cooperation and Development (OECD) member countries pertaining to small and medium enterprises (SMEs). Aims of the study were to assess the current role of SMEs as generators and users of innovations, to analyze the components of a favorable climate for innovation in SMEs, and to improve relevant governmental policymaking. After examining the relationship of SMEs to technological development, researchers concluded that since the majority of SMEs face inherent obstacles to use and promotion of new technologies, only a relatively small portion of SMEs are able to initiate new technological/scientific advances. Analysis of the ways in which innovators emerge in society and achieve economic success led researchers to find that the following factors are essential to stimulation of innovation: receptivity of individuals, supportive networks, adequate financial support, and protective and regulatory systems. While the considerable differences between governmental policies of OECD nations prevented researchers from formulating general recommendations to member nation governments, they were able to formulate three directions in which public authorities might modify or complement their current actions. These are promoting social receptivity, developing financial incentives, and improving the competitive and regulatory framework. (MN)

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INNOVATION
IN SMALL AND MEDIUM FIRMS

A Report by the
Committee for Scientific and Technological Policy

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This Report constitutes the synthesis of a study by the OECD Committee for Scientific and Technological Policy on technological innovation in small and medium firms and related government policies.

To implement this study, the Committee set up an Ad hoc Group made up of representatives of governments of Member countries. The Group's work culminated in the preparation of the following Synthesis Report and its subsequent adoption by the Committee.

This text is based on a set of data and analyses compiled by the Secretariat in a series of three Background Reports published in a separate volume.[1]

1. *Innovation in Small and Medium Firms - Background Reports*, OECD, Paris, 1982.

SUMMARY

For more than seven years the OECD countries have been living through a difficult and uncertain period. Technical innovation, which occurs continuously and at an increasing pace, has been widely recognised as a key factor in overcoming the obstacles that bar the road back to satisfactory equilibrium. Technical innovation is needed for improving industrial competence, and for maintaining an open trading system. It is needed to help reduce energy consumption and lower dependence on imported raw materials. It is a social necessity for responding to increasing concern about health, environment and working conditions, and more generally a better quality of life.

Against this background, the reasons which lead governments to promote innovation in small and medium firms are recalled in Part I of the report:

1. Small and medium firms are an important part of the economy which account, when defined as units with less than 500 employees, for more than half of industrial employment in most Member countries. Small firms need to be able to call upon all available technical resources to help them solve their specific problems. This can ensure their own prosperity. By this they contribute to the national well being.

2. Small firms have shown remarkable ability as purveyors of innovations, in particular in industries characterised by high growth rates and technical change. These firms' abilities need to be exploited and developed, and measures taken to increase the number of such innovative small firms.

These arguments underline the importance of this study, which has mainly attempted to :

— analyse the roles of small and medium enterprises (SMEs) in contemporary technical changes, according to their different places in the industrial structure;
— identify the basic features that climates conducive to innovation should have;
— outline the features of comprehensive government policies to stimulate innovation in small and medium enterprises.

The situation of SMEs in the pathways of technical change, and their contributions to it, are analysed in Part II of the Report. A fair number of SMEs do innovate either in the normal course of business or in a phase of product diversification and adaptation; however, few SMEs are interested in innovation for its own sake. It is estimated that only about one-tenth to one-fifth deliberately undertake innovative activities. These range from in-house R & D to scouting for new products.

Most of the innovative activities of SMEs consist of propagating the technologies that are currently being transferred from advanced sectors, and particularly those like micro-electronics and new materials, which underlie the present technical change. The SMEs' role is to invent a wide variety of applications for those technologies. In doing so, SMEs play quite an important part in diffusing technology through the industrial system as a whole.

On the other hand, some SMEs are active in speeding up industrial applications of discoveries or new concepts coming from large industrial, governmental or university laboratories. In doing so they often advance new techniques to a level of risk acceptable to large firms; and they sometimes open the way to new industries.

Involving larger segments of existing SMEs in innovation encounters a series of inherent obstacles. Most SMEs come to innovate when pressed by socio-economic constraints and above all by competition. However, an enquiry made in the course of this study suggests that innovative capacities can be stimulated by reinforcing technical competence within firms, by providing technical assistance, and by remedying financial problems.

The formation of new technology-based firms raises further issues. Although they are poorly documented, the rate of formation appears to be quite small — a few dozen a year — in many countries. This lack of growth points may create problems for economies in a phase of restructuring.

Characteristics of climates conducive to innovation are examined in Part III of the Report. Several basic features are:

- the development of receptivity of individuals to innovation, which depends on basic attitudes, and technical and managerial skills to be developed through education and training systems;
- widespread dissemination of support networks where innovators can find reception, advice and assistance, and testing facilities to advance their ideas;
- multiple and diversified possibilities of financing to reduce the hindrances created by aversion to risk;
- proper competitive and regulatory conditions to open or to keep open access to markets for new ideas, products or firms.

In short, producing an innovative climate for SMEs consists mainly of developing capacities for taking initiatives, and providing space for their realisation. The role of governments is not only to provide incentives and support but is also a matter of measures leading to changes in education, research, business, administrative or financial practices. Such measures may require a political willingness broader and different from direct intervention or conventional support.

The components of innovative climates identified above, as well as an inventory of the measures implemented in twenty Member countries, suggest that comprehensive policies encompass three facets: the promotion of receptive structures in society as a whole, measures for the financing of innovations and actions on the competitive and regulatory framework. These are sketched out in Part IV.

For the first facet — promotion of receptive social structures — we shall stress in this summary :

- The need for concrete measures in education, and particularly at the level of higher education (including the professional schools) to motivate students for industrial life and to give them practical skills.
- The deployment of networks for technical information, training, assistance and research. Governments have set up vigorous programmes for these purposes recently, but needs remain difficult to satisfy. Procedures are suggested to broadly involve private bodies as well as public ones (like technical universities) in the development of these services on a regional basis.

For the financing of innovations, numerous measures have been taken in most countries, specifically for the benefit of SMEs, to improve their access to official aid for industrial R&D and government-contracted R&D. These efforts are often significant and should bear fruit. In fiscal matters special attention needs to be given to small firms, in particular to the taxation of corporate profits and capital gains. Governments have taken steps to facilitate the provision of risk capital to small firms through guarantee systems and the creation of specialised institutions; it is also desirable to implement measures in order to attract big investors (such as merchant banks and insurance companies) into venture capital markets, to revitalise local stock exchanges and to steer individual savings towards innovative firms.

Within the competitive framework matters of intellectual property are first discussed: aspects of importance for SMEs are the simplification of patent applications and approvals, protection of the rights of employee inventors, and reduction of the cost of litigation procedures. Adequate anti-trust laws and their enforcement also play a role in the vitality of SMEs. Lastly there is a need to examine, and sometimes reduce, government regulations affecting the innovative activity of

SMEs and offering them fair access to public sector procurement contracts.

This study has attempted to provide a framework for further enquiries. More systematic collections of data on SMEs' innovative performances, formations of new-technology firms, obstacles hampering innovation and efficiency of government measures will help in the design and application of better policies.

I

BACKGROUND TO THE STUDY

The Member countries of the Organisation for Economic Co-operation and Development consider that, in the current economic climate, the innovative potential of small- and medium-sized firms (SMEs) should be promoted in view of their role in industrial activities and the substantial contributions that SMEs could make to technical progress.

The new economic context

In recent years the OECD countries have experienced a particularly difficult and uncertain period. Several OECD studies have analysed and defined probable future world economic trends.[1]

Economic growth has declined but unemployment and inflation have increased. The oil crisis is a major factor in curtailing growth, and significantly reduces the real value of national incomes. The world pattern of industrial activities has shifted; although the United States is still ahead, in many fields it has been caught up by Japan and some European countries; at the same time, some of the developing countries are becoming rapidly industrialised and are competing with the developed countries in several sectors.

These world changes have stimulated technological competition, not only between the Member and non-member countries of the OECD, but also within the OECD countries themselves, in order to seek new markets and to reduce production costs. The capacity to adapt in the short term is limited and could engender disguised protectionist measures.

Moreover, greater public concerns about the needs to protect the environment against pollution, and to improve health and safety in the working place, which emerged towards the end of the 1960s, are now being translated into legislation and regulatory processes with consequent effects on many industries.

1. Relevant OECD studies are: *Facing the Future: Mastering the Probable and Managing the Unpredictable*, Paris, 1979; *Technical Change and Economic Policy*, Paris, 1980; *North-South Technology Transfer — The Adjustments Ahead*, Paris, 1981.

Adaptation to this changing situation is proceeding within the OECD Member countries at different rates depending on their particular circumstances. The chief aspects of these policies have been examined and guidelines formulated,[2] but the capability for technological innovation is crucial to this adjustment.

Technological innovation is one of the key factors required to:

- reduce the extent of energy and raw materials dependence;
- improve productivity in manufacturing (which is basic to overall economic growth) in existing concerns;
- open up new fields for investment, manufacture and employment, to increase existing stock and break the "zero-sum" situation into which industrial societies are currently locked;
- stimulate new types of industrial units and new products in relation to social concerns.

Governmental interest in SMEs has two main facets. Historically, small firms have a proven record for innovations which requires further exploitation. Secondly, SMEs make an important contribution to economic activities in general, and their prosperity derives from technical advances they achieve.

The nature of innovation

Innovation can take many forms; for example:

a) a familiar product manufactured from new materials (such as clothing from new types of synthetic fibres);
b) a fresh combination of existing products to give improved performance (for example, stronger materials from a mix of wood and plastics);
c) adaptation of an existing product to meet new demands (for example, airships for the carriage of freight);
d) a new product utilised to perform a new function (for example, photo-electric cells to collect solar energy);
e) a new process either to make a new or modified product or to lower production costs (for example, shoe making equipment to exploit new adhesives that replace stitching).

Innovation commences when a technical possibility fulfils an economic and/or social demand. It can be defined as a new technical item successfully launched on the market. Thus innovation may be regarded as a continuous process from the inception of an idea, through the stages of implementation (research, development and possible manufacture on a commercial scale), to marketing. Innovation includes the concept of invention (the creation of a new object).

2. *The Case for Positive Adjustment Policies*, OECD, Paris, 1979.

Innovation has two main sources. It may be completely empirical, or it may draw upon the results of pure or applied research. Additionally, art may inspire innovation where design results from hybridisation of esthetics and technical concerns. Even when innovation exploits research results, it requires initiative exogenous to research.

By its very nature innovation is not easy to predict. However, it comes always from curious and open minded people able to make relations between phenomena, which would not have been made without them. It is their ability to connect the unrelated that often characterises innovators.

SMEs and technical progress

Small firms and individual inventors are deemed (according to surveys made in the 1960s) to have accounted for many important innovations made since the beginning of the century. Modern industrial societies grew out of small firms and many large enterprises began as small innovative ventures.

Technology has increased in complexity and industrial research has become concentrated in a few large firms. Recent OECD statistics show that more than half industrial R&D in OECD Member countries is undertaken by forty large firms. Nevertheless, small firms — at least in some countries — continue to be very active sources of innovation: for example, it has been estimated that firms employing less than 1 000 people contributed more than 40 per cent of the "major" innovations in the United States in the early 1970s.

Two factors which favour small firms, compared with large firms, are profit-making and their structure.

Whereas large firms generally seek profits by improving existing product lines (due to constraints imposed by their size and competition), small firms endeavour to exploit the resulting gaps in which expensive conversions are not required in order to venture into small, new, or risky markets or products.

Large firms have hierarchical management structures presenting an established and organised competence, but small firms are generally loosely structured and possess flexibility of response to new demands, and of exploitation of new ideas.

Thus small firms can make a relatively large contribution to technical progress, and serve as the embryos for growth industries.

SMEs in the economy

Small- and medium-sized firms are characterised by their styles of management and ownership: responsibility for strategic decisions

rests with one person or with a small team and the capital is held in a similar manner; the firm's influence in the total national economy is modest, if not negligible. Although reference may be made to turnover, value added or to the number of employees, definitive criteria for SMEs are lacking and vary between sectors and in different countries.

In most Member countries, SMEs are taken to be firms employing no more than 500 persons and on that basis, they account for between 45 and 70 per cent of the industrial labour force. These percentages are lowest in the larger countries and those which underwent the earliest industrialisation (for example, France, Germany, the United Kingdom and the United States). The highest percentages are found in smaller or more recently industrialised countries (for example, Australia, Ireland, Japan, the Mediterranean and the Scandinavian countries).

In certain sectors of industry the majority of employees work for SMEs which then have a corresponding share of the total output and turnover in those sectors. For example, in most countries, SMEs employ 80 or 90 per cent of the work force in the plastics and textile industries, and between 60 and 80 per cent of those in the food and agricultural industries.

However, the importance of SMEs depends on qualitative considerations too. The fabric of many regions is made up of small production units which provide jobs for local populations of limited numbers. Industrial relations are also more personal, and often have a greater involvement so that the two aspects of life — work and non-work — may be more easily integrated.

Large firms have advantages in the economy of scales of production in relatively narrow ranges, and may offer better working conditions and wages for their employees. On the other hand, small firms may stimulate competition and strengthen industry as a whole by providing a counter-balance to the large firms.

The effect of current economic stresses on small firms is difficult to assess in the absence of post-1977 data. In some countries small businesses appear to have withstood these stresses better than larger ones, but elsewhere, the trend seems less favourable. More information is required before concluding whether expansion should be stimulated in the first instance or disintegration halted in the second case.

Innovation is a factor which consolidates, and may enrich the SMEs as a whole. However, from this point of view, more attention will be paid to the diffusion and adoption of new technology at a satisfactory rate than to the promotion of radical innovations. Such a diffusion conditions the renewal of existing production processes and also the diversification and improvment of product lines.

Aims and methods of this study

The aims of this study were to:

a) assess the current role of small firms as generators and users of innovations;

b) analyse the components of a favourable climate for innovation in SMEs;

c) improve relevant governmental policy-making.

Having regard to the wide variations in the industries and technologies of Member countries, and the consequent scale of enquiries which might be needed, it was decided to conduct a survey by utilising the experiences of some one hundred experts from twelve Member countries, covering about twenty different industries. Information was also obtained from other surveys concerning the contributions of SMEs to specimen innovations, statistical data on their share of R&D, and estimates of the number of new technology-based firms.

In order to complement this macro-economic perspective, and to ascertain at the micro-economic level, the conditions which affect innovation in small firms, use was also made of recent analyses and studies on the processes of innovation in such firms and by individuals. Three seminars hosted by three Member countries and attended by innovators and their associates were organised, in conjunction with research and training institutes. These seminars dealt respectively with product conception, management of innovation and financial implications.

The main conclusions from these analytical processes are presented in Parts II and III of this report.

On the basis of these findings, and of a systematic inventory of measures adopted by some twenty Member countries to stimulate innovation in small firms, a number of actions are suggested whereby governments might continue, adapt or enlarge their policies for such incentives, and these are described in Part IV.

II

SMALL ENTERPRISES AND TECHNOLOGICAL DEVELOPMENT

Following a brief review of the ways in which the diverse SMEs assist with technical progress, the nature of their contribution is identified through the propagation of technologies throughout the industrial system, and through speeding up the development of new technologies.

General considerations

SMEs range in technical competence from those firms disinterested in innovation to those which are highly motivated and possess defined strategies for it. However, it seems probable that the "typical" small firm shows less desire and capability for innovation than is often credited to it by public authorities.

In general, SMEs are aware of the technical developments in their specific fields, but many have little knowledge of progress which lies outside their own industries. Such awareness may be drawn from commercial contacts, trade fairs and exhibitions, professional associations, chambers of commerce and industry, or from the technical press. The extent to which SMEs can utilise new technologies also depends on the level of their own technical competence, or "technical culture"[3].

A firm that exhibits a high innovative capability is characterised by an agressive commercial and technological attitude, frequent calls on advisory and consultant services, discerning use of contacts, and sometimes the use of outside R&D facilities. Such a competence is found in perhaps 10 per cent of SMEs. A smaller percentage undertakes effective in-house R&D, and pursues a defined strategy for innovation.

Finally there are those SMEs which are entirely dedicated to innovation and which are categorised by such terms as "new

3. "Technical culture" is a concept understood in French-speaking countries which is not employed in English-speaking countries. Its meaning is the corporate knowledge and know-how ordered in the human mind so as to predispose a person to recognise and exploit technical developments successfully.

technology-based firms", and "spin-off" or "hive-off firms"[4], to which one should add those firms which are created to market new products invented by others.

Overall the SMEs are only a modest force in national industrial research. Towards the end of the 1970s, firms with less than 1 000 employees contributed about 5 per cent to (measured) national expenditure on industrial R&D in the United States, and 10 per cent in Germany; firms with less than 500 employees accounted for about 5 per cent in the United Kingdom and 10 per cent in France. Although SMEs have a little share of the overall R&D effort, they play important roles in the technological progress.

In order to attempt to assess such roles, one may utilise a model recently suggested by historians of technology which, although simplifying reality, provides a satisfactory representation of the modus operandi of technological progress. This seems to operate through the exploration and development of technological "breakthrough" into advanced sectors of industry, followed by progressive transfer of technologies, generally limited in number, which gradually fertilise industries. Due to necessary interdependence these technologies consequently form a "technical system".

We are now in an age of diffusion and transfer of technology. From enquiries made in Member countries concerning the preparation of their national technological programmes, it seems that these currently relate to several large technical streams; for example, micro-electronics; new materials such as techno-polymers, glues and composites; new forms of energy systems such as microwaves and heat pumps and advances in organic chemistry. Most innovations in SMEs draw partly on those technical streams, thus the SMEs can contribute to their promotion and spread.

At the same time, new technologies are emerging side by side with this process of gradual fertilisation, for instance, advanced biotechnology. Some of them will become the components of a future technological system destined to supplement or replace those in the present scheme of things. Some SMEs will assist in this fulfilment or renewal process, generally by accelerating the application of research from the point reached in private, public or university laboratories.

Propagation and diffusion of technology

The SMEs, although proportionately less active at the level of technological breakthroughs or new generic technologies which

4. "Spin-off" firms are firms set up by individuals who leave large companies, taking with them specific technical know-how. A "hive-off" firm is a small firm created out of a part of a large company; it is set up as an independent company usually because its activities are outside the mainstreams of the activities of the large company.

condition the use of these breakthroughs,[5] have, by virtue of their position in the industrial structure, a unique role to play in their spread. It seems that this is the task of SMEs, particularly in the renewing of the bases of industries where there are many opportunities for new markets but whose narrowness discourages entry by large firms. SMEs fill technological gaps in the same way they fill production and commercial lacunae: they do so by investigating the niches in the market place. This in turn leads to saturation of existing technical sub-systems, and the possibility that a new technological "breakthrough" may occur.

Nevertheless, investigations showed that most SMEs seem only to innovate when impelled to do so by the pressures for survival, through competition, by new socio-economic pressures, by increases in the costs of energy or of primary raw materials, by new regulations about conditions of work or by wage increase. Normally the average SME does not anticipate an event by preparing a formal innovative strategy; indeed many enterprises survive with no innovation.

Generation of innovation thus largely depends on competition, especially from large firms and from developing countries. The response to these pressures is usually in two stages. Firstly, marginal alterations are made to the ranges of products, exploiting changes in fashion where these are possible (for example in products for mass consumption), or in personalising services for customers, or in specialising in high quality products. Next, firms attempt to make major modifications to their range of products by adopting technologies which are new to that particular sector.

In the propagation and diffusion of technology, three types of sector may be distinguished. The first, characterised by a relatively high technical level in which the SMEs face direct competition from large firms, has a marked innovative climate, and embraces, in particular, industries of high technological level such as computers and its hardware, and mechanical engineering and its offshoots. In the second group, the SMEs predominate and compete as equals; stimulation is influenced mainly from outside by technologies introduced by suppliers and from collective centres for research; innovation consists of adopting new processes and diversifying the products; this group includes traditional industries such as furniture and footwear, but also growth activities like solar heating. The third group consists of firms making semi-finished products and engaged in sub-contracting; here innovation is conditioned by the relations existing between the SMEs and their suppliers and particularly with their industrial clients, and the climate is very progressive.

5. For example, automatic or numerical control condition applications of the micro-processor.

Thus technologies diffuse into SMEs from their industrial partners, the SMEs are stimulated vertically by both customers and suppliers and horizontally by collective research centres, competitors and especially by large firms which they complement, compete successfully against, or which compel them to adapt. The behaviour of partners thus determines the dynamism of SMEs in general and can be stimulating, stifling or even lethal.

On the other hand, the reception given to new technologies is conditioned, as we have seen, by the "technical culture". The latter is as important to the spread of innovation as research is to discovery. Its importance is illustrated by the European watch and clock-making industries. Even though they were alerted towards the end of the 1960s by the far-reaching commercial and technological changes set in motion by micro-circuits and liquid crystals which was to revolutionise their sector, they were unable to face the problems due to lack of technological preparation in an activity staffed by professional mechanics.

According to experts interviewed in the course of this work, competence seems to be lacking in several industries in most Member countries. There appears to be a need for training in, and help with exploiting technology. Of about equal importance are the problems of financing technological innovation. Of less immediate importance, that vary according to industrial sector, are the needs for assistance with management and marketing, and with the problems caused by regulations and patents requirements.

A limiting factor to innovation is the weak intrinsic capacity for R&D in most small and medium industries. New technologies may be costly to adopt. Since it appears that only ten per cent of SMEs have an R&D capability, the spread of technology will be slow. Moreover, such transfers demand partnership between industries which produce new technologies and those which are recipients, but this is difficult to generate because of differences in technical and socio-industrial backgrounds.

From this review it appears to be difficult to involve a larger segment of the SMEs in innovation which is generally a slow and step-wise process. It requires external pressures from industrial partners (having regard to the range of networks with which SMEs are involved), and strengthening of their own technical competence and R&D capacities.

Development of new technologies

SMEs are particularly effective in the application of specific discoveries or developments to the production of high performance goods designed for emerging, as well as for older and fragmented

markets. Examples may be found in health care and medical equipment (lasers), telecommunications (fibre optics), security and analytical detection equipement (software). SMEs also have expertise in many specialised industrial processes (for example, in the surface treatment of metals). In such areas the problem is often one of continual adaptation of non-standard products, or of products which as yet lack technical perfection, in close co-operation with consumers.

In traditional sectors, such as textiles or metallurgy, where technological progress is slightly affected by technology transfer from other sectors, and depends largely on their internal dynamism, SMEs contribute directly or through co-operative research centres to the improvement of production process and product lines.

Finally, one has the situation — chiefly in the United States — in which SMEs assure the promotion of those technologies on which new industries are founded. For example, in the last decade, SMEs which today are important firms, were the first to invest in micro-electronics. Nowadays, small firms (often established and managed by university research workers) are pioneering the initial steps towards the industrialisation of genetic engineering discoveries. However, unlike the electronics situation, small firms engaged in such activities are confined to conceptual and process designs for large firms of which they are often subsidiaries.

Thus contrary to some public beliefs, technological "breakthroughs" are not the monopoly of large public, university or industrial laboratories, but may involve small firms and even individuals. Furthermore, there is every indication that such a pattern will continue in the future. In consequence, it is appropriate to analyse the reasons for this situation and the ways in which SMEs can promote promising discoveries in industrial production processes.

Such an analysis would be particularly useful for the European Member countries where this situation occurs less frequently. For example, comparison of the more active sources of spin-off (universities, public laboratories and industrial firms) in those countries with North American experience, could be useful to develop a strategy for new firms.

The formation of new firms

The previous analysis suggests the prime importance of forming new firms to develop technologies, amongst which the creation or exploitation of new technologies is a special case. The latter pose particular problems of risk, but, at the same time, offer great potential for the development and growth of whole new industries.

Because documentation in national statistics is insufficient, and clear definitions are still to be developed in statistical terms, the rate of

formation of innovative firms — i.e. based on design and development of new products — is not well known. However, we can count the new technology-based firms listed on the stock market in the United States. In the 1960s there were some 150/200 flotations annually; between 1969 and 1975 the number dropped almost to zero, but seems now to be mounting again, with some 50 recorded in 1978. Well established data from other countries are lacking; however, judging from the number of firms which have approached public venture capital organisations, it may be estimated that there are possibly about 40 new technology-based firms created annually in the larger European countries in Canada and in Japan.

In order to obtain more complete data, it would be necessary to take account of such firms created by other financial means, for example through conventional banking facilities, private investors or personal funding, or the foundation of subsidiary companies by large enterprises. Nevertheless, even making generous allowances for these opportunities, it appears that the *rate of formation of new technology-based firms is low in most OECD Member countries.*[6] In restructuring national economies, such a lack of potential growth points may create some problems, particularly when allowance is made for firms which fail (not necessarily on technological grounds) in their early years.

A recent survey in the Netherlands has shown that new technology firms arise in traditional as well as advanced industrial sectors, and in service sectors (such as health and transport) as well as in manufacturing.

Limited studies in the United States in the 1970s showed that young high technology companies provided new job opportunities at a very much greater rate than in the « mature » companies. However, the limiting factor for the young companies in this respect was the ceiling for growth which generally provided opportunities for only a few dozen and seldom more than several hundred employees. The explanation may lie in the constraints imposed by the penetration of small firms into particularly narrow niches for their products. It therefore follows that many new firms would be required to counterbalance job losses incurred by the run-down of a few older firms.

Changes in the overall industrial system in response to the steeply rising costs of research development and marketing have also led to a new function for SMEs: namely to progress a technique or idea to a risk level which becomes acceptable to large firms. Such a role may lead to a take-over by the larger firm. From the macro-economic standpoint,

6. There are many more industrial firms created — a few thousand annually in the larger countries. Although few seem very innovative, these new firms carry, to a certain extent, innovative projects as they seek to supply products which are only partly, or not yet, commercialised by established firms.

this fate does not diminish the value of the SMEs, and the key functions of revitalisation of the economy and the provision of new growth points might even be enhanced by such absorption.

Concluding remarks

The previous analysis identifies several issues:

a) the inherent obstacles to the involvement of a larger segment of the SMEs in using and promoting new technologies;
b) the importance of SMEs which are concerned with the promotion of advanced technologies and the consequent creation of new industries;
c) the relatively low rate of initiation of new technology/science based firms in many Member countries.

In the light of such considerations, governments are reviewing their policies for promoting innovation in SMEs. It is important that the underlying processes by which innovation arises in SMEs be considered in order to clarify the scope for future measures.

III

CONDITIONS FOR INNOVATION IN THE SMALL FIRM

In order to develop meaningful policies for the stimulation of innovation, it is desirable to have an understanding of the ways in which innovators emerge in society and achieve successful economic conclusions to their projects.

Factors which are relevant to such an identification include development of receptivity in the individual, provision of support for the innovator, adequate financial backing and mechanisms for preserving the confidentiality of the idea, and its access to the market place.

Receptivity of individuals

The generation of innovation involves appropriate attitudes, competences, an environment enriched with relevant information, and facilities for mobility.

The innovative attitude includes appreciation of a challenge, ability in experimentation, and a desire to question established views and to further progress. Many innovators are motivated to solve social problems as in areas of health (equipment for the handicapped), transport (electric vehicles) or the conservation of energy and materials. Financial returns may be assessed on a longer timescale.

Competence relates more to the utilisation of technical information and "know-how" than to basic theoretical knowledge, and requires a long apprenticeship to such problems. Open-minded and flexible attitudes are needed in order to select the major components and associate them into an optimum pattern. Commercial elements include capabilities in management, finance and marketing.

Current education systems have great relevance since they fashion future industrial leaders. The primary school can generate conceptual creativity; at secondary school level familiarity with industry and technology can be initiated on a broad scale.

Universities provide basic technical, commercial and vocational training and arouse the interests of students: engineering and business schools have special relevance in these respects. However, courses

may be oriented to select able students for administration in central government, large firms or for established disciplines of research, rather than to innovation and entrepreneurship. In consequence, many countries have found that those schools generate a modest number of innovators.

Maintenance of technical competence is basic to established industry and commerce, and concerns a variety of bodies such as regional and sectoral research organisations, professional associations, management institutes and labour unions. Large firms should be involved in maintaining competence by providing new technologies to smaller firms and serving as customers for their products. Such external participation is valuable to SMEs which are liable to experience greater difficulties in recruiting high grade staff and in paying adequate salaries to retain their services than larger firms; moreover, regulations for job security can make it difficult for SMEs to shed labour when no longer required.

Receptivity is stimulated by inputs of a variety of information or by events such as meetings, press articles and competitors. SMEs, although normally well informed in their own fields, are often less aware of related fields, and this could lead to stagnation.

Easy mobility, offering the prospect of rapid results, contributes to the formulation and realisation of new projects. Thus mobility is conducive to innovation. It is influenced by institutionalised factors. For example, research workers in large organisations are reluctant to take risk commitments which might prove incompatible with established programmes; on the other hand, mobility may be favoured by industrial practices such as creating subsidiaries to promote employee projects. Mobility is also encouraged by regulations such as those protecting employee inventors, but is discouraged by other regulations such as restrictive conditions on transfer of pension rights.

Supportive networks

Creativity and enthusiasm of innovators depend often on the interest shown by immediate contact groups who in turn help to elaborate the ideas. Experience shows that the genesis of innovation lies in cross fertilisation within small groups of people involved in common projects.

Barriers to new ideas lie in the scepticism of outsiders, especially when the ideas are controversial. Contact groups in society thus have an important role and can include technical clubs, small business associations and other organisations. The effectiveness of such groups varies greatly in different countries partly depending on their status in relation to society and government. Nevertheless, such organisations provide a forum in which requirements for specific expertise may be identified, and suitable sources for expertise can be suggested.

The needs for commercial and technical information are especially crucial in the conceptual phase of ideas when critical choices are being made. Such information can normally only be extracted by highly qualified interrogators capable of packaging the information in forms immediately comprehensible to, and usable by, the innovators. Unprocessed information from a data base is generally of little value. Moreover outside technical assistance is essential especially in relation to tests and pre-production models as it requires complex and expensive equipment and specialised capabilities.

Ideally information and supportive organisations should be available on a regional level and spread on a wide geographic basis. But they should be networked with national and international knowledge bases and expertise. Furthermore, these organisations should be interdisciplinary and operate across established industries which are often self contained and may even be closed systems. Creation of such cross links opens systems to technology transfer and makes this available to SMEs. Otherwise the SMEs would be locked into the knowledge bases of their own industrial streams.

In addition there is a supplementary feature which is the presence of a *promoter* for the innovator and his product. Whereas large firms with sophisticated management systems normally have in-house specialist promotion staff, the scientist/engineer, who originated an idea in the R&D department, will seldom be entrusted with progressing the product to the market place. For an SME not large enough to have an in-house promoter, an outside agent may be of great assistance.

The function of a promoter is to assist the innovator to surmount barriers such as complex and obscure language in official organisations; long delays in responding to requests for funding; the costs and time involved in litigation; communication problems in disciplines outside those of the innovator; and general inertia.

Financial considerations

Although there are wide variations, it appears from the budgets of public authorities and venture capital companies which finance innovation, that costs from two to five hundred thousand United States dollars may be incurred in bringing a "typical" innovation to the market. Incremental developments may be obviously less expensive.

Expenditures may be broken down into three stages; conceptualisation leading to a design or feasibility study; Research and Development ending in a prototype and, finally, when the model is almost fixed, pre-production, production and marketing. The design and feasibility studies amount to only a few per cent of the total costs, but the technical research phase can be expensive and extend over several years, particularly if the relevant basic technology has not been

established. (Recent Canadian studies indicate that the latter could amount to half the costs of succesful innovations.)[7]

Private innovators and small firms thus often encounter financial problems beyond their resources, especially at the research stage; moreover, the prospect of a return on an investment may be very long term. Firms entering these fields for the first time and lacking both financial reserves and a track record have particular difficulties in raising finance.

Consequently, innovators explore all potential sources of funding: personal savings, bank credit systems, medium — and long — term loans, share options and debentures, secured contracts to supply, and public sector money (if available). The package of funds put together by an innovator is usually heterogeneous. It will often have an equity loan ratio that would be considered imprudent by a conventional financier. In practice the funds are mainly limited to public subsidies, venture capital firms and banks.

Public subsidies are frequently given for R&D expenses, and to some extent for post-prototype development. However, public bodies have limited budgets and are usually restricted by legislation as to the amount of money they can spend. They have to be selective, and their lending criteria are seldom well-defined. Further, being bureaucracies they are often difficult for SMEs to approach. Recently however, public pressures have led to regionalisation of grant-giving procedures and to accelerated approvals and quicker payments of grants and subsidies. New forms of aid have been created to help with costs of R&D personnel and external contract R&D commissioned by SMEs.

Private and publicly supported venture capital companies tend to avoid the R&D related high-risk long-term projects. They prefer to support actively the later market-near stages of innovations that offer rapid returns. Further, they must also be selective and support only the most promising applicants.

Banks are cautious concerning funding innovations because they lack the experience and methodology to evaluate technical prospects, have problems of communication with the innovator and tend to overestimate the risks of the proposals which the innovator underestimates. However, studies show that, after its initial years, a technology-based firm has a better survival prospect than a non-technical firm.

Studies have shown that the financial obstacles to the realisation of projects by the SMEs tend to be related to the extent of centralisation of potential money supplies: in consequence, less concentration and more competition would be favourable.

7. See « Small and Medium Firms and Technical Change », Background Report n° 1, Chapter II, in *Innovation in Small and Medium Firms — Background Reports*, Paris, 1982.

Protective and regulatory systems

Innovators can usually exercise little leverage on other organisations and thus better protective mechanisms are required. These should include acceptance by society in general, and by banks in particular, that there is a need for a learning period; that confidentiality must be guaranteed especially against economically stronger competitors, and that market and regulatory forces do not inhibit introduction of a new product.

Established industrialists may be intolerant towards innovators who need their advice and operational exposure but who learn much through experience. Failure of entrepreneurs due to lack of such experience may, in most Member countries, other than in North America, be regarded as a stigma. Statistics indicate that most new firms will fail, but there is evidence that a second venture may be more successful than the first. Hence measures to overcome an initial failure could facilitate a quicker start on a second attempt.

Most innovators seek to protect their ideas by filing patents. However, in many sectors in which SMEs are active — basic computer and other software, biotechnology, genetic engineering and microelectronics — patent protection is either impossible or very difficult to obtain. Possession of a patent is an important factor in persuading venture capitalists to support a project and can be a lever in licence negotiations. An appropriate and manageable patent system is an asset to the innovator.

Although innovations seek to meet market needs, monopolistic or restrictive trading may kill these attempts. Because of the dependence of SMEs on technical and industrial networks, it is essential that these networks be kept accessible by anti-trust and anti-monopoly measures. Although legislation is difficult for technical aspects, it may encourage large firms to be as open as possible to technological transfer, including the import and export of new ideas, techniques, materials and products. It follows also that innovations are most likely to flourish in markets which are fragmented, fluid and unrestricted by technical norms and standards.

Concluding remarks

An attempt has been made in this chapter to identify the components which help to stimulate innovators and which favour expressions of their creativity — in short those which produce an innovative climate embracing both the development of capacities for initiatives and creating the space to absorb them. This process is a long one which effectively involves society as a whole and operates best at a local level. A long period of gestation is required to bring an innovative policy to fruition. It can be effective when it makes an impact on the

public and social structure and involves behavioural patterns and attitudes, through appropriate institutional pressures and adjustments.

Governmental tasks are stimulation without interference or the erection of bureaucratic structures which themselves are an obstacle to innovation. Nevertheless, there are feasible measures which public authorities could take, and in some cases, have already taken. These will be considered in the final part of this report.

IV

ELEMENTS FOR GOVERNMENT POLICIES

Evolution and framework of policies

Governments have sought for a long time to promote innovation and technology by legislation. Patent Acts, based on the Paris Convention of 1883, were amongst the earliest measures to encourage and reward inventors. Anti-trust and anti-monopoly laws, initiated in the United States in 1890, were aimed at protecting and promoting competitive economies which would be open to the entry of small and new firms with innovative ideas.

Consolidation and institutionalisation of the scientific and technical bases of industrialised countries, and developments between the wars and during the post-war reconstruction, have generated instruments for technical research with an industrial emphasis, such as associations for industrial research and technical centres for specific purposes. Public authorities have encouraged the creation of such facilities and quasi-public funds have financed them. Government institutes for industrial research have been launched. Such measures have been particularly fruitful in smaller countries where private funds are less available.

The 1960s were characterised by progressive reduction tariff barriers, expansion of international trade, key roles for technological innovation in securing and maintaining economic growth, and government support for industrial R&D in almost all countries. This period also saw the introduction, especially in the larger countries, of big programmes in aerospace, defence and nuclear technologies.

Towards the end of the 1960s, and particularly with the publication in 1967 of the "Charpie Report"[8] by the United States Department of Commerce, specific demands emerged for an innovation policy separate from both research and industrial policies,[9] and led to a range of institutional reforms to improve the climate for innovation.

8. *Technological Innovation: Its Environment and Management,* US Department of Commerce, Washington, D.C., January 1967.

9. See OECD publications on *Policies for the Stimulation of Industrial Innovation, Analytical Report* and *Country Reports* (3 volumes), Paris, 1978.

In the 1970s, especially since the 1973 crisis, it was accepted that innovation policy demanded attention at the highest levels of government. Measures adopted in several OECD Member countries have recently been reviewed,[10] and these have since been augmented.

Although a growing importance is attributed to SMEs, their status in contemporary innovation policies varies between countries. Some countries have aimed the majority of relevant measures at the SMEs, because they are either deemed to be a key element in the renewal of the technical industrial fabric, or because it is considered to be advisable to counter-balance the extensive funding received by large firms in the 1960s.

Other countries addressed such measures to the whole industrial community and not especially to the SMEs. In a few countries measures were directed at both the large firms and at providing special support for the SMEs.

Innovation policy beneficial to SMEs has three main facets (see Part III and the inventory made in the course of this study) :

a) measures to consolidate or improve *infrastructures for information, technical training and technical R&D,*
b) *fiscal and financial measures* to facilitate R&D funding and innovation in SMEs,
c) *measures relevant to competition* such as anti-trust laws, patent and licence procedures and governmental rules and regulations.

The first type received renewed attention from several government and generated extensive programmes. The second facet often arises in response to particular problems identified by SMEs. The measures adopted in the third area although not specifically addressed to SMEs are relevant to them because they facilitate relations with large firms.

The extent and range of direct assistance and indirect measures vary in relation to national, social and institutional backgrounds.

In some countries the policy conception arises within a general framework generating a basket of relatively structured and interdependent measures, whereas in others the approach is more piecemeal. Such differences stem more from traditions concerning the extent of government involvement in orienting industrial activities than from specific interventions.

Some governments from time to time adopt measures to stimulate specific activities, but in other countries these functions are mainly the concern of the active private sector.

10. See the countries' contributions at the Meeting of Senior Officials on Innovation Policies, held at OECD on 17th and 18th June 1980: *Innovation Policy: Trends and Perspective*, OECD, Paris, 1981.

Since there are considerable differences between government policies, and background concepts, as well as their industrial climates, *there is no suggestion of formulating general recommendations to Member country governments* in this study.

However, in this review of the three areas where governments can take action, *an attempt has been made to formulate the directions in which public authorities might modify or complement their current actions*. It is necessary in all cases to consider the pertinence and practicability of implementing these possibilities in relation to national situations.

This review is based on the sum of our own analyses, on available views elsewhere on evaluation of policies, and also upon the examination of the opinions expressed at the three seminars.

Promoting social receptivity

A policy for innovation, especially one aimed at its promotion in SMEs, can be rendered fully effective by starting at the grassroots. It is proposed in this report to consider firstly how to generate in the public a climate favourable to the emergence of innovators. This may be achieved primarily through educational means, secondly the motivation of the SMEs themselves, and, finally, networking of information and technical assistance including the role of co-operative industrial research.

Education and training

Innovation *per se* can be a goal but it is mainly a means for adapting and adjusting to a new environment.

In order to achieve adaptation by means of technical creativity in individuals and small firms, an understanding of the meaning of innovation and of relevant promotion is needed to facilitate the development of the innovators themselves. Groups in society particularly likely to be concerned by these matters are management and labour unions, scientific and technical associations, regional organisations and consumer associations. All have their roles, but of fundamental importance is the educational system.

Higher education, including the professional colleges, merits more concrete measures. Some experiments (e.g. in top-level universities in the United States, in engineering schools in France) have given encouraging results. Lessons which might be learnt are: to combine instruction in engineering and management; to train pupils in product design and the creation of enterprises; and to involve students in fullscale real-life projects, preferably in association with innovative work in industry.

Other governments could stimulate such experiments in their countries by motivating implementation at institutional level, and by

promoting linkages between technical and commercial/management education which are too often taught in separate curricula or even at different centres. Innovation — the union of a technical possibility to a commercial opportunity — has less chance of gestation if two separate brains are needed to formulate and develop new ideas.

Continuing education and specialised re-training promote manpower flexibility and mobility. Employment in new firms and in innovative environments require special motivation and skills. Training should take these into consideration.

Motivating small firms

Promotion of awareness is particularly important in those firms which exhibit little motivation for innovation until it is too late and their survival is threatened. Simple stimuli may be adequate in a variety of ways, for example : regional fairs and exhibitions, competitions for firms and individual innovators, wide distribution of relevant brochures. Augmenting such measures, which may evoke interest in groups other than just the SMEs, suggests a way forward.

It is also very helpful to provide competent people on a regional basis to visit SMEs and research workers to put them in touch with financial, scientific and technical organisations. For example, in France, the Industrial Relations delegates, and in Sweden and in the United Kingdom, the Industrial Liaison Officers are deemed to be effective in stimulating innovation. Germany, the Netherlands and Japan have initiated campaigns to mobilise private consultancy services and Portugal is involving public organisations.

Special attention should be given to the development of innovation-oriented management capabilities in existing SMEs: training programmes could efficiently be implemented at regional level, involving in particular technical and commercial universities and colleges.

Many measures may be needed to invigorate whole communities such as minority groups or depressed areas where the commercial and technical infrastructures are not existent. Such communities need to take initiatives to mobilise their own commercial, technical and financial resources. Public authorities can assist this mobilisation with complementary funding and by linking these targeted campaigns into the overall national efforts. Examples in Europe and North America show that such campaigns are possible and fruitful.

Services for innovation

Well developed technical cultural backgrounds for industry and information services, technical advice and training may be found in certain Scandinavian countries, in Germany, and especially in Japan. In Japan some 200 local government laboratories (an average of four to each prefecture) are dedicated to these purposes. To a large extent

such services are provided by co-operative industrial research associations and branch research institutions, subsidised by government in many countries. Although presenting a high level of competence, limited manpower and financial resources restrict their influence.

Recently impetus has been given to these services by most governments, including those of countries which are already well equipped. These measures include national coverage by regional agencies for scientific and technical information, and centres for technical assistance supported by universities and public laboratories. At some of these centres, entrepreneurs and their employees can test their inventions and become familiarised with new equipment (for example, at Japanese local government institutes). Such measures lie within the framework of general national programmes and the State normally finances a proportion of the operating costs, in response to initiatives from industries and regions (illustrative examples may be found in France, Denmark or Italy).

Such measures seem to succeed in creating interest in those industrial groups at which they are aimed to the extent that these services become quickly saturated by the demands made upon them. Although it is a matter for national decision regarding the extent of support, it would seem desirable to examine the merits of stable and longer term funding to replace the current ad hoc and discontinuous approach.

Financial procedures have to be adapted to national social and economic structures and the nature of their institutions. Possible measures include : agreed permanent financing by central government for regional institutions to facilitate the creation of the appropriate services; fiscal levies on industry (modelled on employment taxes imposed in some countries); or fiscal incentives for firms devoting funds for the development of certain measures.

In order to achieve maximum efficiency, these services must be linked to technical research. In Japan the relevant laboratory personnel effort is divided between research, testing and technical assistance to, and training of, engineers and technicians. That is the most direct method and possibly the most effective way to fertilise SMEs with research results and, inversely, to define the research programmes of the centres in terms of problems which are significant to the SMEs.

Such advisory structures culminate in *collective research* including the industrial research associations and the branch technical centres. These organisations have shown their great value in certain countries and in specific sectors. However, lack of resources has meant that collective research centres can seldom launch major programmes. Moreover, they sometimes fail to respond to the specific needs of SMEs.

Some countries, like Germany, the United Kingdom and Belgium, have promoted co-operative research or reorganised existing institutions, or improved their links with SMEs. However, in many countries, the total financial and manpower resources devoted to collective research remain modest.

In principle, collective research is of great importance to SMEs. It affords a unique way of promoting the basic technologies used by many of them. It demands a limited effort from each firm but, in aggregate, can form a critical mass which can make a significant contribution towards technical progress.

A coherent fresh approach could develop collective research by involving greater resources and by mobilising larger segments of the total scientific and technical communities. Suggestions and initiatives for the research programmes should originate in the SMEs. Financing should confer benefits (such as tax allowances on subscriptions). The selected programmes should relate mainly to technologies relevant to several industries in order to promote cross fertilisation and technological transfer (which have been stressed earlier in this study). Programmes would be mainly contracted out to scientific and technical organisations, such as public laboratories, universities, and possibly large firms.

Developing financial incentives

Government support for R&D

In the majority of countries, up to the mid-1970s there were no special aids for SMEs. Government-supported R&D consisted of contracts let to firms connected with big programmes and of support and subsidy schemes for specific industrial sectors. The SMEs only received a modest share of this public funding. According to OECD estimates for 1975, in the United States 80 per cent of the funds went to firms with more than 25 000 employees; in France 90 per cent went to the 20 largest firms; in Sweden 98 per cent went to firms employing more than 1 000 people. There was a similar pattern in other larger Member countries. However, the proportion of the R&D expenditures of SMEs provided by public funds was often greater than in the case of the large companies.

Recognition of the need of SMEs led governments to adopt a range of new measures including regionalisation of the grant-giving structure to facilitate access by small firms, special programmes for inventors and small firms, subsidies for the costs of R&D personnel and special schemes (subsidies in the form of tax credits) for R&D contracted out by SMEs ("premiums to innovation").

In procurement policies, particularly in the United States, « set aside funds » are reserved for SMEs, and more stress is placed on government support for unsolicited proposals generated by small

firms. Unsolicited funding, as shown by United States experience, may well be of greater importance than government R&D contracts to implement in-house concepts, in order to stimulate innovative projects originating in high technology small businesses.

Some of these forms of aid are making impacts and thus confirm the existence of an unsatisfied demand from SMEs. It should be noted that in some countries these aids for SMEs have increased rapidly and redressed the imbalance. However, these aids, at least when they are direct, are difficult to administer; the criteria for project evaluation are imprecise; and it is impracticable to ascertain whether direct assistance to one firm may not harm a competitor. Finally, if aid becomes disproportionate, market balances could be disturbed so that support becomes counter productive.

Thus, when assistance has been substantial, further increases may not be profitable. Alternative strategies, such as simplification of application procedures for funding, campaigns for better information inputs and more rapid payment of sums due to small firms, may be better. Schemes should allow firms to use part of the allotted funds for commercial and market research related to the technical research, particularly when the project in question in reality combines both these aspects.

Taxation

Many fiscal measures can affect innovation in small firms such as: tax credits for R&D expenditure; reduced tax rates or easier payment conditions for small and new firms; and preferential treatment for licence and patent income. Moreover, overlaps between personal and company taxation may affect SME's owners.

The extent to which industrial R&D expenses are tax deductable varies between OECD Member countries. It ranges from deductability with an added premium to no special treatment outside normal business costs. In this respect SMEs rarely receive special treatment.

Although comparisons between actions in different countries and the effects should be considered, in general fiscal measures have only a limited effect on SMEs, because few of them undertake the R&D to which the fiscal measures may apply. It was for that reason that direct grants were made in order to encourage SMEs to contract out their R&D. Moreover, since innovation comprises more than R&D, it is consistent to ease the tax burden in other ways.

Special considerations apply to new firms. Several countries have reduced taxation on them that partially compensates for their inability to carry over tax losses or investment write-offs from previous years' trading. In the United States there is some relaxation of taxation on capital gains made by investors in new firms, and this has been claimed as a factor in the renewed interest in the flotation of new technology firms.

It is suggested that attention might be given to more lenient taxation for inventors, particularly with regard to the income from royalties. Some countries, such as Germany, have incorporated this measure in their legislation for inventor protection; others, such as Ireland, have provisions related to their patent laws.

Better fiscal treatment of investments made in stocks and shares seems desirable in order to redress the balance regarding venture capital, where, at present, few investors will risk their money in backing innovation, but many may speculate in gold, lotteries or property.

Venture capital

To the extent that venture capital markets are insufficient, particularly in European countries, governments have been forced to intervene in these markets in several ways. Notably they have developed systems of state guarantees for loans made by commercial banks to entrepreneurs. They have also created public sector venture capital companies, for example following the model and experience gained in the United Kingdom regarding the National Research Development Corporation (NRDC). Such companies usually operate with a package of loans, equity participation and loans which are convertible into equities. Other governments have encouraged by fiscal means the creation of companies for financing innovation.

Although public sector involvement is generally intended to be temporary or limited, there is a risk that it becomes permanent, thus substituting public funds for private investment in the long term. Moreover, measures to create companies to finance innovation have sometimes proved disappointing. Complementary actions would thus be useful. There are many untapped funds as yet unconnected with the venture finance market, including merchant banks, insurance companies and pension funds : their involvement could benefit venture capital by diversifying the base of its funding.

A policy for greater diversification of funding would involve several measures such as a re-appraisal of the rules and regulations for banks and similar institutions; adjustment of the taxation framework and the rules of conduct for insurance companies to enable them to create guarantee funds for the benefit of innovators; and relaxation of the rules regarding the safeguarding of pension funds to permit the investment of at least part of their assets in new and venture businesses.

Finally there is a need to revitalise and reverse the decline of stock exchanges. In many countries secondary markets no longer exist, over-the-counter dealing has diminished, and local and regional stock exchanges have closed or become absorbed into the national exchanges. Regulations for the conduct of stock exchanges have also become more rigid and complex. In order to reverse these trends, many measures would be required but would be an integral part of

strengthening regionalisation and simplifying regulations. Both these aspects would favour the activity and growth of small firms.

Improving the competitive and regulatory framework

Governments have long been aware of the needs in these fields which may be discussed under the headings of intellectual property protection, anti-trust legislation and restrictive regulations.

Intellectual property

The patent systems of several countries have been amended, modified and modernised in recent years. The actions which have been taken to up-date and increase the resources of patent offices, to improve the access to information in patent searches and to streamline the process for a patent application are of benefit to SMEs. By a single application to the recently established European Patent Office, a European patent may be obtained which is acceptable in eleven countries of Western Europe.

Although patents may be a source of information for SMEs, they are not invariably used to protect their inventions. This is because of the costs and time required to obtain patent protection, the long time lapse between application and approval, and the costs of litigation or prosecution for defence in the event of infringement of patent rights. Other methods of property protection which are simpler and do not require costly legal advice, such as registered designs, are often suitable for small firms. Although such simplified systems benefit SMEs, they are not always an adequate substitute for patents.

Access to patented information and licences from public sector research centres has, until comparatively recently, been difficult for SMEs because they are seldom contractors to these centres and thus have no interface with them. In several OECD Member countries efforts are now being made to advertise the work of these centres and to release research results to the open market in the form of patents and licences. Information may also be disseminated by contact bureaux, newsletters and search systems for matching demand and supply profiles. Such efforts should be welcome to SMEs and help to reduce the number of patents that are filed but not utilised. Greater awareness of the possibilities of filing patents and the industrial applications of their work is required from scientists.

When a large firm does not wish to exploit new discoveries itself, it should be encouraged to use other organisations or to help create a new enterprise to do so. Apart from the fiscal aspect of corporation taxes, public sector involvement in this spin-off process is slight.

The public sector is directly involved when its own employees wish to start their own firms. This occurs most frequently in the universities

and in public laboratories. Such a process seems to present few problems in the United States, but in Europe various obstacles, in particular personal financial constraints, seem to discourage spin-off from the public sector. This situation could be eased by a greater transferability of pension rights and security provisions which often apply to government laboratories. Systematic re-employment possibilities for staff involved with new industrial ventures could also be very conducive to spin-off.

Governments can prepare and enact legislation for the protection of employee inventors. Such legislation, whether laws, regulations or codes of practice, where applied and properly enforced, is deemed to be a powerful incentive both for an employee to develop his inventions and for the employer to use them. However, in many countries, there is as yet no legislation, or the legislation does not apply fully to public sector employees.

Anti-trust legislation

Most OECD Member countries have anti-trust laws but their coverage varies between countries. The anti-trust laws of Canada, Germany, Japan and the United States and the EEC are strict and they provide for high civil penalties, and in Canada, Japan and the United States they also provide for criminal penalties. EEC Member States are subject to the EEC anti-trust rules, even though they may lack relevant domestic legislation. Many of these laws are applied less strictly to the SMEs for example, in co-operative purchasing, marketing or research between the SMEs. In the United States, the Small Business Act provides an anti-trust exemption for co-operation between small businesses.

The objective of anti-trust law is to promote the most efficient utilisation of resources by preserving free, open, competitive markets through the elimination of cartels, monopolies and other non-competitive practices. Anti-trust laws aid the innovator in selling or licencing his innovations by providing a competitive market place. In such market places innovations have an enhanced value to prospective purchasers because of the presence of competitive rivals. Anti-trust laws also ensure that competition is not unnecessarily restrained. For example, anti-trust laws prevent abuses of industrial property rights, such as conditions attached to the sale or licence of the innovation which might seek to impose an unjustified acceptance of other goods or services.

Many anti-trust laws are drafted as general framework legislation needing regulations or case law (or both) to specify their meaning. Hence most anti-trust systems provide a notification or review procedure, which allows for a prior determination of the legality of a proposed business operation. Proposed joint research activities or licensing agreements are notified to the anti-trust authorities in

Germany, Japan and the EEC for any necessary modifications and for clearance before being put into effect. In the United States, there is a business review clearance through which the Anti-trust Division of the Department of Justice may state its intentions for enforcement with respect to the proposed business conduct.

Firms may impose restrictive conditions on employees who leave in order to set up their own businesses or to work for a competing firm. Several countries have laws governing unfair competition which permit the placement of restraints which are reasonable as to their time and scope in order to achieve a balance between the innovative interests of employer, employee and society.

Considering the significance of fair competition regarding its contribution to innovation, and the possible impacts of anti-trust laws, some countries might wish to review their present systems, with a view to amending current or drafting fresh provisions in order to fill identified gaps.

Public regulations and public procurement

Public authorities intervene in many areas by making rules and regulations which affect the innovative activity of SMEs. Special attention is desirable concerning regulations on the industrial production of goods and on public sector procurement.

Regulations about the characteristics of products or the conditions of manufacture are often designed to promote public well-being such as environmental protection, public hygiene, health and safety in the workplace and energy conservation. Responses to such measures may stimulate both innovation and SMEs to create new industries. Examples of such responses are new types of analytical instruments, and the development of heat pumps and solar panels.

The increase in the volume of regulations is criticised by large firms, but is more likely to affect adversely SMEs lacking the resources to appraise regulatory texts. They will benefit from shorter, more simple and better co-ordinated regulations.

Regulations concerning the specifications of goods for sale, rather than their function/purpose, are an inherent obstacle to innovation (process innovation may however depend on a stable product specification, and be stimulated by stability). Provision is needed for testing new supplies and new products for their suitability to fulfil public requirements. The increase in public liability insurance affects SMEs. Disincentives to innovation should be reduced. The additional costs of studying the impact of such regulations are best circumvented by collective research.

Regulations which govern the conditions of supply of products and public services, such as telecommunications and transport, can hamper competition and innovation. The United States are seeking to

reduce these impacts and other countries may wish to review such measures in the light of their national situations.

Governments have sought to promote the share of SMEs in contracts for public procurement of goods and services by increasing awareness of the possibilities for tendering, by simplification of procedures and better publicity. These provisions are very useful and need to be widely applied. But experience also shows that changes do not always take place as fast as has been wished, or attain the stated objectives. Various practices may exclude suppliers from tendering procedure: for example, over-precise or too detailed specifications. Detailed scrutiny of the situations might make it possible to identify such genuine obstacles.

Moreover, governments increasingly make it a condition of acceptance of tenders from large firms that they subcontract work to SMEs. Monitoring the effects of such measures is difficult, but increasing the industrial community's awareness of its responsibilities towards SMEs must be beneficial.

Major efforts are still needed in order to stimulate innovation through aggregation of the demands of local and regional authorities, especially across a range of social technologies such as transportation, building and public utilities, in which SMEs might play an important role. For that purpose, training of local authority staff, responsible for specifications and negotiations, in a background knowledge of technology, innovation and the role of SMEs could be valuable.

Finally, it must also be acknowledged that any form of bureaucracy and administrative requirements puts a much heavier burden on small firms than on large ones, and this fact should be taken into consideration. Some countries have taken steps to reduce the administrative and paperwork burden, and to simplify procedures for grant applications.

Issues related to developing countries

The United Nations bodies (UNCSTED, UNICO, UNCTAD) have favoured and shown an interest in SMEs which are possible sources of that technology which is nearer to the requirements and capabilities of developing countries. Doubtless such discussions, and the emergent lines of policy, influence the plans of developing countries for industrialisation; nevertheless, it is difficult to evaluate the activities of these bodies in these different fields. For their part, the developed countries may have a growing concern to see SMEs involved in international trades since this may help to increase flexibility during the adjustment process.

An excessive increase in control procedures and a cumbersome bureaucracy in international relations would not facilitate the involvement of SMEs. However, a more concrete and continuous technological and industrial dialogue between industrialised and developing

countries — creating for instance appropriate flows of information — could help SMEs to participate more easily in trade and technology transfer.

Final comments

The above are the major elements identified by this Group as the constituents of wide-ranging policies for the promotion of innovation in current small- and medium-sized enterprises. The spirit and type of actions are a reflection of inspiration rather than organisation, of incentive rather than aid, of vigilance rather than regulation. Hence the special character of these policies, and the problems of those charged with framing and applying them.

However, policies would be more easily designed and conducted if better information bases were developed in order to gauge the effects on the communities to which they are addressed and their impacts on innovative activities and performances.

Governments could give full effect to their policies by encouraging and taking account of socio-economic trends which favour small firms and by attempting to minimise those trends which disadvantage small firms.

Trends which could be encouraged are:

- more attention paid to regional development, taking the SMEs more particularly into account in the policies to be implemented;
- the diffusion of technology with several and varied applications, notably micro-electronic systems, new materials, and information networks which end the isolation of small firms, and a shift towards the "knowledge" industries;
- heightened interest in the participation of employees in firms' internal management, including the smaller ones, which might be a source of dynamism and creativity;
- a rising conviction in an increasing section of the community that, in order to overcome the current recession, a special effort might be required to return to the dynamism of the individual by promoting programmes favourable to new firms.

Adverse trends appear to be :

- persistent social attitudes which are unfavourable to the independent businessman; increasing social cost factors and regulations of all kinds which raise the real cost of production; and the growth of non-wealth creating employment in public sector organisations;
- the increasing costs of capital goods investments and of Research and Development, and the entanglement of technology in large and inflexible institutional systems;

— the increasing complexity of numerous industrial and trade activities (e.g. in the export/import field), which demand costly processes and highly developed management aptitudes;
— widespread aversion to risk situations which, during a period of high uncertainty, may lead towards restrictive macro-economic and trade policies.

Modern industrial societies have a massive task to adjust to the new economic situation they are forced to face. And perhaps, when all things — favourable winds and adverse currents — are considered, the main way to renew innovation and small firms is in attitude of mind and behaviour. The role of innovation policy is to encourage follow up of the unexpected, search for the hidden thing and belief in the unthinkable.

Annex

AD HOC GROUP ON INNOVATION IN SMALL AND MEDIUM FIRMS OF THE COMMITTEE FOR SCIENTIFIC AND TECHNOLOGICAL POLICY*

Chairmen** : Mr. van Trier (Netherlands)
Mr. Flubacher (Switzerland)

Australia	Mr.	Crawford
	Mr.	Kelly
	Mr.	Cobban
	Mr.	Metcalfe
Austria	Mr.	Ratz
	Mr.	Draxler
Belgium	Mr.	Bernard
	Mr.	Bieseman
	Mr.	Desguin
	Mr.	Lizin
Canada	Mr.	Chand
	Mrs.	Baird
	Mr.	Bellanger
Denmark	Mr.	Ladegaard
Finland	Mr.	Aulio
	Mrs.	Salminen
France	Mr.	Darrieulat
Germany	Mr.	Bornemann
	Mr.	Krupp
	Mr.	Meyer-Krahmer
	Mr.	Jacobi
Greece	Mrs.	Malaspina
	Mr.	Loucopoulos
Ireland	Mr.	Healy
	Mr.	Moore
	Mr.	O'Doherty
Italy	Mr.	Pedinelli
	Mr.	Porcasi
	Mr.	Zanotti
	Mr.	Galloni
Japan	Mr.	Tsukuda
	Mr.	Shimo
	Mr.	Mukai
Netherlands	Mr.	Tindemans
	Mr.	de Graaf
	Mr.	Pennings
New Zealand	Mr.	Foster
	Mr.	Benzie
Norway	Mr.	Austveg
	Mr.	Mortensen
	Mr.	Thoresen
Portugal	Mr.	Feria
	Mr.	Texeira-Gomes
Spain	Mr.	Orozco Perals
	Mr.	Espino Mena
Sweden	Mr.	Nyren
	Mr.	Henhow
Switzerland	Mr.	Elias
	Mr.	Weilenman
	Mr.	Imhoof
Turkey	Mr.	Kesmez
United Kingdom	Mr.	Price
	Mr.	Lusher
	Mr.	Fowler
	Mrs.	Coleman
United States	Mr.	Woleck
	Mr.	Morris
Yugoslavia	Mrs.	Kosak
	Mr.	Dropenik
	Mr.	Radovanovic
CEC	Mr.	Benzler
	Mr.	Goodman
	Mr.	Watson

Secretariat : Mr. Aubert
Science and Technology Policies Division
Mr. Proctor (consultant).

* The composition of Member countries' delegations has in some cases changed over time. The above list includes all delegates who have participated in the meetings of the Group.

** The Ad hoc Group was initially chaired by Mr. van Trier, Delegate of the Netherlands to the Committee. After Mr. van Trier was appointed Netherlands Minister for Science Policy, the chairmanship was taken over by Mr. Flubacher, Delegate of Switzerland to the Committee.